wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

REMARKS

At the outset, the Examiner is thanked for the thorough review and consideration of the present application.

The Examiner's Final Office Action dated December 26, 2000, has been received and its contents reviewed. Claims 73-144 were pending in the present application prior to the instant amendment. By this amendment, claims 73, 80, 87, 93, 99, 105, 111, 117, 123 and 129 have been amended. Subsequently, claims 73-144 are pending, of which 73, 80, 87, 93, 99, 105, 111, 117, 123, and 129 are independent.

Referring now to the Office Action, claims 73-144 stand rejected under 35 U.S.C. § 103 as allegedly unpatentablle over Zhang (U.S. Patent Nos. 5,614,733, or 5,604,360, or 5,563,426) in view of Yamazaki (U.S. Patent No. 5,543,636). The rejection is respectfully traversed.

The present invention is characterized in a semiconductor device comprising no grain boundary in a channel region or a crystalline semiconductor island.

Independent claims 73, 80, 87, 93, 99, 105, 111, 117, 123, and 129 have been amended, as shown above, to further recited the features of the mobilities of a p-channel thin film transistor and an n-channel thin film transistor. Support for the amendment can be found in at least, e.g. Fig. 5 of the present application.

Applicant respectfully submits that none of the cited references disclose the mobility having the claimed range, although Zhang '426 teaches a field mobility of 300 cm^2/Vs in a thin film transistor using a silicon film re-crystallized by laser annealing. A field mobility of a NOS transistor formed on a normal monocrystal silicon substrate is around 500 cm^2/Vs (see col. 2, line 63 through col, 3, line 10 of Zhang). However, the NOS transistor on the monocrystal silicon substrate has a different state from the claimed thin film transistor and other thin film transistors of Zhang '426, which do not disclose the claimed mobilities.

Further, Applicant is submitting herewith a corrected Fig. 5 with the correction shown in red ink along with a letter to the Official Draftsperson requesting review and consideration of the drawing correction. Applicant respectfully notes that the MOBILITY unit of Vs/cm^2 in Fig. 5 should be cm^2/Vs to conform to the correct unit shown throughout the specification, such as that shown in page 2, line 7 of the specification, for example. Clearly, the unit of Vs/cm^2 in Fig. 5 was a typographical error.

In view of the arguments and amendments set forth above, Applicant respectfully requests the § 103 rejection of claims 73-144 be reconsidered and withdrawn.

CONCLUSION

Having responded to all rejections set forth in the outstanding Final Office Action, it is submitted that claims 73-144 are now in condition for allowance. An early and favorable Notice of Allowance is respectfully solicited. In the event that the Examiner is of the opinion that a brief telephone or personal interview will facilitate allowance of one or more of the above claims, the Examiner is courteously requested to contact Applicants' undersigned representative.

Respectfully submitted,

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VERSION OF AMENDED CLAIMS WITH
MARKINGS TO SHOW CHANGES MADE

Please amend claims 73, 80, 87, 93, 99, 105, 111, 117, 123 and 129 as follows:

73. (Thrice Amended) A thin film transistor comprising:

a crystalline semiconductor island over a substrate having an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions:

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said channel forming region has no grain boundary, and

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said semiconductor island includes a spin density not higher than 1×10^{17} cm^{-3},

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing a point defect in the crystalline semiconductor island,

wherein the thin film transistor is a p-channel thin film transistor or an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

80. (Twice Amended) A thin film transistor comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film on at least said channel forming region;

a gate electrode over said channel forming region having said gate insulating film therebetween,

wherein said channel forming region has no grain boundary, and

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said semiconductor island includes a point defect of 1×10^{16} cm^{-3} or more, and one of hydrogen and halogen element for neutralizing the point defect at concentration not higher than 1×10^{20} cm^{-3},

wherein the thin film transistor is a p-channel thin film transistor or an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

87. (Twice Amended) A semiconductor device comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said crystalline semiconductor island is formed in a monodomain region which contains no grain boundary,

wherein one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

93. (Amended) A semiconductor device comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said channel forming region is formed in a monodomain region which contains no grain boundary,

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

99. (Twice Amended) A semiconductor device comprising:

a p-channel thin film transistor;

an n-channel thin film transistor;

each of said p-channel thin film transistor and said n-channel thin film transistor comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said crystalline semiconductor island is formed in a monodomain region which contains no grain boundary,

wherein said crystalline semiconductor island include one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

105. (Twice Amended) A semiconductor device comprising:

a p-channel thin film transistor;

an n-channel thin film transistor;

each of said p-channel thin film transistor and said n-channel thin film transistor comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said channel forming region is formed in a monodomain region which contains no grain boundary,

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1 x 10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

111. (Twice Amended) A semiconductor device including an electro-optical device comprising:

an active matrix circuit portion including at least a first thin film transistor;

a peripheral driving circuit portion including at least a second thin film transistor;

said second thin film transistor comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5 x 10^{18} cm^{-3}, and oxygen at a concentration not higher than 5 x $10^{19}cm^{-3}$,

wherein said crystalline semiconductor island is formed in a monodomain region which contains no grain boundary,

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1 x 10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

117. (Twice Amended) A semiconductor device including an electro-optical device comprising:

an active matrix circuit portion including at least a first thin film transistor;

a peripheral driving circuit portion including at least a second thin film transistor;

said second thin film transistor comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said channel forming region is formed in a monodomain region which contains no grain boundary cm^{-3},

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

123. (Twice Amended) A semiconductor device comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said crystalline semiconductor island is formed in a monodomain region which contains no grain boundary,

wherein said semiconductor device has a S value of 0.03-0.3,

wherein said crystalline semiconductor island includes one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-1000 cm^2/Vs.

129. (Twice Amended) A semiconductor device comprising:

a crystalline semiconductor island on an insulating surface;

source and drain regions in said semiconductor island;

a channel forming region between said source and drain regions;

a gate insulating film adjacent to at least said channel forming region;

a gate electrode adjacent to said channel forming region having said gate insulating film therebetween,

wherein said crystalline semiconductor island includes carbon and nitrogen at a concentration not higher than 5×10^{18} cm^{-3}, and oxygen at a concentration not higher than $5 \times 10^{19} cm^{-3}$,

wherein said channel forming region is formed in a monodomain region which contains no grain boundary,

wherein said semiconductor device has a S value of 0.03-0.3,

wherein said crystalline semiconductor island includes

one of hydrogen and halogen element at concentration not higher than 1×10^{20} cm^{-3} for neutralizing point defects in the crystalline semiconductor island,

wherein the semiconductor device includes at least one selected from the group consisting of a p-channel thin film transistor and an n-channel thin film transistor,

wherein the p-channel thin film transistor has a mobility in a range of 200-400 cm^2/Vs while the n-channel thin film transistor has a mobility in a range of 500-100 cm^2/Vs.